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Net Economic Value of Elk Hunting in Idaho

Cindy F. Sorg and Louis J. Nelson

Abstract

Net willingness to pay in addition to actual expenditure for elk hunting in Idaho was estimated at $63.17 per trip and $99.82 per trip using a standard cost per mile travel cost method and a reported cost per mile travel cost method, respectively. Using the contingent value method, the values for the 1982 and 1983 elk hunting seasons were $51.84 per trip and $92.54 per trip, respectively. Willingness to pay was greater for double number of elk seen on a trip. Methods, results, and applications are fully described.

Acknowledgements

This study was a cooperative effort of the Idaho Department of Fish and Game; the University of Idaho College of Forestry, Wildlife, and Range Sciences; the USDI's Bureau of Land Management and the Fish and Wildlife Service; and the USDA Forest Service.

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The Net Economic Value of Elk Hunting in Idaho

Cindy F. Sorg, Research Wildlife Biologist
Rocky Mountain Forest and Range Experiment Station[1]

and

Louis J. Nelson, Staff Biologist
Idaho Department of Fish and Game[2]

[1]Headquarters is in Fort Collins, in cooperation with Colorado State University.
[2]Headquarters is in Boise, Idaho.

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MANAGEMENT IMPLICATIONS

Wildlife-related recreation clearly has value, but estimates of this value are difficult to establish. This is partly because of different definitions of economic value and widespread misunderstanding of economic terminology. This bulletin analyzes the value of elk hunting in Idaho, using both estimates of consumer surplus (net willingness to pay of the user) and expenditure as components of total value for consumptive use of the elk resource. Other types of value exist for nonconsumptive use.

In analyses of the economic efficiency of resource allocation, consumer surplus values generally are useful, whereas expenditure data are inappropriate or irrelevant, although they are useful for analyses about sectors of an economy. This bulletin explicitly focuses on economic surplus benefits (useful in economic efficiency analyses), although some expenditure data are reported.

Benefit-cost analyses and federal and state wildlife planning programs, such as the USDA Forest Service's FORPLAN and the BLM's SAGERAM, involve determining whether the benefits of implementing a project exceed the costs of the project. When the net willingness to pay of the gainers exceeds the net willingness to pay of the losers, once all costs have been removed, then the investment is economically efficient or the benefit-cost ratio is greater than 1. For a project like a controlled burn to improve elk summer forage, the gains might include increased hunting opportunities because of increased elk population and the losses might include forfeiting another species that requires old-growth vegetation, decreased timber activity, or restricted cattle grazing.

In 1982, the net economic value of an Idaho elk hunting trip to the hunter and to the Nation was estimated to be $99.82 (table 3). This means the typical hunter would be willing to pay an additional $100.00 per trip. The gross value is the sum of $76.00 of expenditures (transportation, lodging, food, ammunition) plus the consumer surplus of $100.00, which equals $176.00 per trip. This value is a state average from which can be derived per day or per Wildlife and Fish User Day (WFUD) values. Because of the statistical properties (functional form) of the demand curve estimated for elk hunting, the average value equals the marginal value of another trip. That is, the additional net value to the hunter and society of another trip is equal to the average value of a trip. This result holds only because of the specific functional form used in this study. It should be noted that the marginal value is the appropriate economic efficiency measure. The reason these average values can be applied in analyses where only marginal values should be used is because the functional form of the demand curve used in this study has the unique property that for consumer surplus, marginal value is equal to average value. (See the appendix for a discussion and proof.)

If the decisionmaker is evaluating the economic benefits of alternative investments in elk management, then the net value of $99.82 is the appropriate value to use per trip. This value can be converted to a 12-hour WFUD for use in FORPLAN or benefit-cost analyses. Converting the trip value to a WFUD based on number of days per trip and hours hunted per day yields $59.87 per WFUD.

The values given above were derived by a demand curve estimation technique called the Travel Cost Method (TCM). This approach statistically infers the bid that hunters would make if given the opportunity to express willingness to pay.

The Contingent Value Method (CVM) was also used in the study to elicit simulated market bids from hunters. This approach was used to measure the value of each trip taken during the season and is, therefore, theoretically equivalent to TCM. The CVM estimate per trip is respectively, $51.84 and $92.54 for the 1982 and 1983 hunting seasons (table 4). These convert to a net economic value per WFUD of $31.06 for 1982 and $36.31 for 1983. For 1983, the CVM portion of the survey also elicited bids from respondents regarding willingness to pay if they could expect to see double the number of elk per hunting trip; the value per trip was $56.85 greater than for existing conditions.

The geographic scope of analysis where the values given above are appropriate should be noted. The values are a weighted average across all sites and as such may not adequately reflect specific site characteristics. Values generated for a given scope, such as a management hunt unit, may not be appropriate for an area of different scope, such as a herd unit. However, an overall consumer surplus value, such as willingness to pay per trip, may be all that is available, and for efficiency analyses, these are more tenable than expenditure values.

Two additional points of clarification are necessary in reference to economic values. The above example extends only to expenditure and consumer surplus values as they relate to the hunting aspect of recreation value. Option, existence, or bequest values (nonconsumptive values) were not considered. To date, no study has addressed the total value framework of any component of a wildlife resource. Further, only general elk hunting license holders were sampled. The hunting values generated by limited hunt license holders are not included in these values estimates. In 1983, 37,800 individuals applied for a limited hunt permit while only 7,600 permits were issued; therefore, the hunting values reported may be an underestimate of total recreational hunting values.

INTRODUCTION

Elk are Idaho's premium big game species. They provide over half as many hunter days of recreation as do the more abundant deer. Idaho is one of only six states in the U.S. where general elk hunting is allowed. In 1981, elk populations statewide were 90,325 and provided 416,660 hunters days and a total harvest of 8,165. As habitat is lost to development and demand for elk hunting increases, careful land use decisions must be made. These decisions must be based on the best available biologic and economic data.

The economic value of wildlife as measured from the national or economic efficiency view is used in federal land management planning by the USDA Forest Service and USDI Bureau of Land Management. While the land or habitat is managed at the federal level, the wildlife itself is property of the state. Coordination of economic value of wildlife is necessary if federal plans affecting habitat are to be compatible with the state plans for management of individual species.

To promote a consensus on the economic value of elk hunting in the State of Idaho, several federal agencies (USDA Forest Service, USDI Bureau of Land Management, and USDI Fish and Wildlife Service) joined with the Idaho Department of Fish and Game to empirically estimate the value of consumptive recreational use of elk in Idaho.

Specifically, the net willingness to pay for elk hunting was analyzed in this report. This provides a consistent set of dollar values that can be used by federal agencies and the State of Idaho for the state and hunt units within the state. These values may serve as the basis of discussion on value of wildlife in national forest planning, BLM range-wildlife investments, Resource Planning Act evaluations of the Forest Service, and on feasibility studies of investments to enhance elk hunting in the State of Idaho.

In addition, this study served as a test of the cost effectiveness of using the Travel Cost Method and the Contingent Value Method for developing resources Planning Act (RPA) values for the 1990 RPA to be conducted by the Forest Service.

METHODOLOGY

Definition of Economic Value

Wildlife resources provide many different values. Each of these values is a component of total value. These component values, which include recreational, option, existence, bequest, and commercial values, can perhaps be best conceptualized in what has been called by Randall and Stoll (1983) a "total value framework" (fig. 1). Each of the values within this framework applies to consumptive uses (hunting, fishing, trapping, etc.) and nonconsumptive uses (observation, photography, etc.) of wildlife resources.

Recreational economic value is the recreationist's willingness to pay over and above the current expenditures for a recreation experience. Option value is willingness

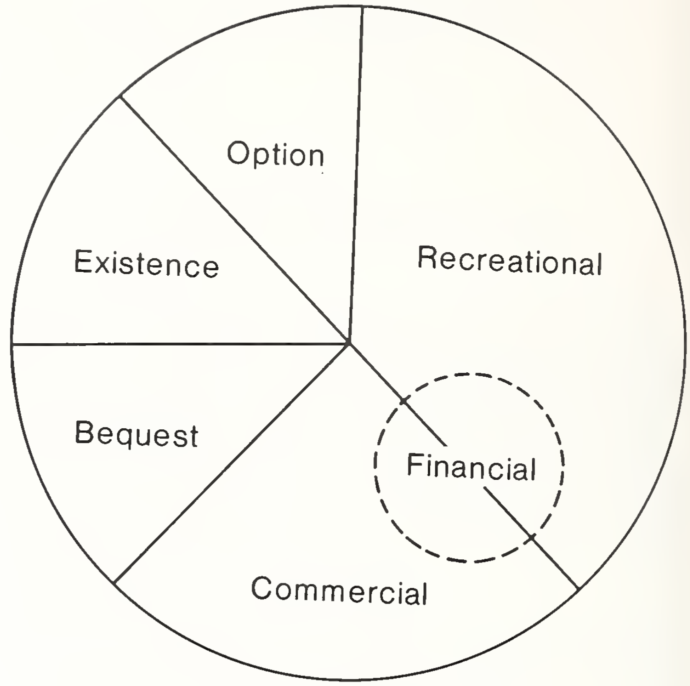

Figure 1.—Total value of wildlife

to pay to maintain a resource so that it is available to use in the future. Existence value is the economic benefit received from simply knowing wildlife exists regardless of one's use. Bequest value is an extension of existence value since it is willingness to pay to provide wildlife resources for future generations.

Expenditure values are often quantified in terms of gross expenditures and are a component of both recreational and commercial values. Expenditures are important from the standpoint of local economies, but do not represent the total economic value of wildlife. Hunters' expenditures can be used to calculate the multiplier effects of expenditures on local income and employment. While important locally, expenditures do not represent the economic value of wildlife from an economic efficiency standpoint. The demand curve in figure 2 illustrates the difference between expenditures and consumer surplus. Consider the elk hunter who has the above demand curve which shows the number of trips the hunter would take when faced with alternative travel costs (i.e., alternative prices). From this curve, if travel costs are $25, the hunter will take 3 hunting trips. Therefore, total expenditures equal $75 (3 × $25) and consumer surplus equals the area above expenditures or $112.50. The $75 provides information on community and multiplier impacts of these expenditures while the $112.50 represents the economic value used in benefit-cost analysis.

Techniques for Measuring Net Willingness to Pay

Dwyer et al. (1977), the U.S. Water Resources Council (1979, 1983), Walsh (1983), and Knetsch and Davis (1966) all recommend the Travel Cost Method (TCM) and the Contingent Value Method (CVM) as conceptually correct

techniques for empirically estimating users' net willingness to pay. The TCM assumes that travel costs can be used as a proxy for price to derive a demand curve. The CVM asks users directly to indicate their willingness to pay, expressed in the form of "bids" for specified recreational conditions (Bradford 1970, Brookshire et al. 1980).

Travel Cost Method (TCM)

The basic premise of TCM is that per capita visitation of a recreation site will decrease as distance to the site and time costs of travel to the site increase. In this study, a Regional Travel Cost Model (RTCM) was constructed. By grouping individuals based on county (or state) of origin, travel costs (and distance) within each county/state zone are approximately constant across all individuals. The dependent variable is trips per capita. Use of the per capita specification adjusts for population differences between counties of visitor origin. As Brown et al. (1983) show, trips per capita takes into account both the number of visits as a function of distance and also

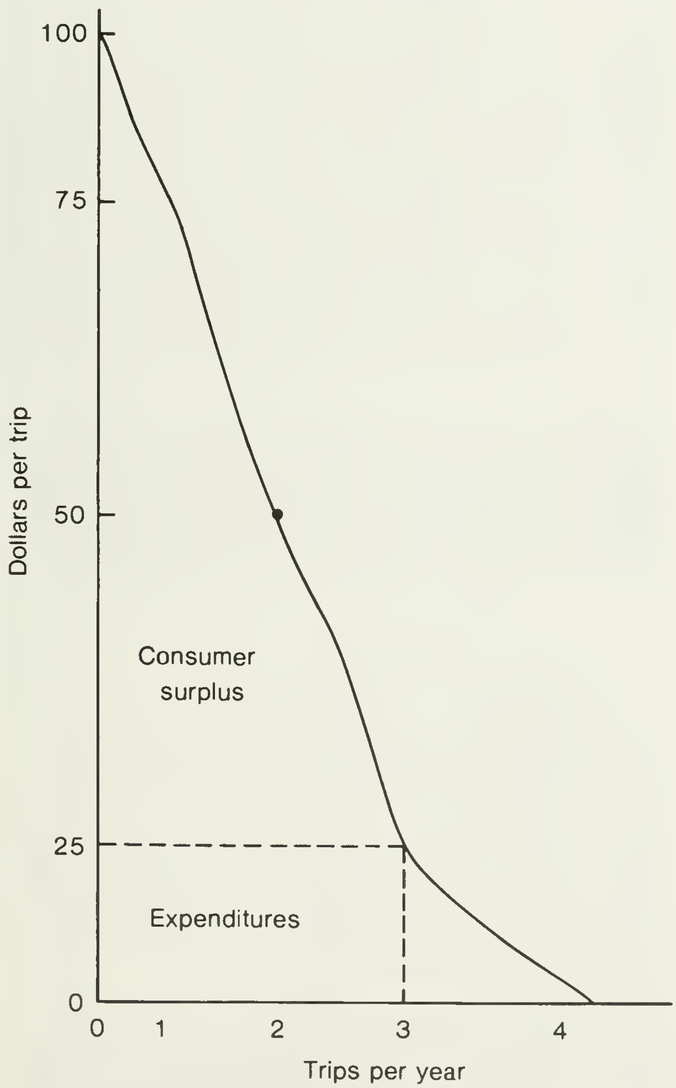

Figure 2.—Hypothetical demand curve for elk hunting

probability of visiting the site as a function of distance. Regression analysis is utilized to estimate a function for visitation rates based on distance, socioeconomic data, and site quality changes. Johnson et al. (1981) described a general functional form:

$$V_{ij} = \alpha_o + \alpha_1 D_{ij} + \alpha_2 S_{ij} + \sum_k \beta_k E_{ki} + \Sigma \gamma_1 Q_{1j} \qquad [1]$$

where:

V_{ij} = annual per capita visits to hunting site j from origin i

D_{ij} = distance from origin i to site j

S_{ij} = recreation hunting opportunities available to population of i as alternatives to site j (substitute sites)

E = demographic/socioeconomic variables for origin i

Q = variables of recreation hunting quality at j.

Equation [1] specifies the per capita demand curve for the hunting sites in the region. By setting the quality measure at a value associated with a specific site, the general RTCM demand curve becomes the demand curve for that specific site. Thus, with one equation recreation visitation patterns for all sites in the region can be modeled. From the per capita demand curve a more aggregated second stage demand curve is calculated. This second stage demand curve plots total trips to a site as a function of hypothetical added distances. Once the hypothetical added distance is converted to travel costs (in dollars), the area under the second stage demand curve represents net willingness to pay. It is net willingness to pay because only the hypothetical added cost is reflected in the second stage demand curve, not the original travel costs (Clawson and Knetsch 1966, Dwyer et al. 1977).

Contingent Value Method (CVM)

Contingent Value Method techniques are most commonly referred to as bidding games. Unlike the familiar market situation where people alter consumption in response to price changes, bidding games can determine respondents' willingness to pay for current conditions and also for hypothetical changes in conditions. Usually the individual is responding to a discrete quality rather than a quantity change in a nonmarket good; e.g., indicating how much seeing wildlife would add to the value of a backpacking trip.

Contingent valuation was first used by Davis (1964). A questionnaire must be designed to present individuals with a well-defined good so that all individuals are responding to the same situation if bids are to be aggregated across participants. Also, if respondents are not fully aware of current conditions or the ramifications of a proposed change, the resulting bids are unreliable. Because hunting is an activity familiar to participants, clearly defining the good is less difficult. However, the survey must explicitly state the area of hunting affected, i.e., value associated with a particular site with all other sites still available, not value of all elk hunting in the state.

Another aspect of survey design is to identify the appropriate "payment vehicle." That is, what payment mechanism is going to be used to elicit the money bid. Possible payment vehicles include entrance fees, license fees, taxes, trip costs or payment into a special fund. In this study, trip cost was used as the payment vehicle since it is fairly neutral and familiar to the respondents and is not likely to elicit a protest bid.

As indicated above, questionnaire design is vital to obtaining a true CVM measure of value. Whereas TCM is an indirect measure of value, CVM is based on a direct measure of value and, therefore, a poor survey design will render useless results. While CVM relies on responses to hypothetical questions, research by Bishop and Heberlein (1979) and Brookshire et al. (1982) indicates that rather than an overstatement of willingness to pay, CVM generally provides conservative estimates.

SURVEY DESIGN AND IMPLEMENTATION

The population sampled for this study was resident and nonresident elk hunters having a general elk hunting license. Limited elk hunt permit-holders were not sampled. The sampling rate for 1983 was 2.1% or 1,629 individuals selected randomly. Table 1 presents the breakdown of the 1983 sampling rate. The economic data were collected in conjunction with the Idaho Department of Fish and Game yearly Big Game Harvest Survey (see appendix). The telephone survey, implemented in January and February 1983, collected information related to the 1982 elk hunting season. Using the same Harvest Survey, muzzle-loader and archery hunters were sampled two weeks after rifle hunters. Stamps permitting muzzle-loader or archery hunting are sold for both elk and deer general hunt permits without a separate stamp issued for each species. Therefore, no data is available on the proportion of elk muzzle-loader or archery tag-holders surveyed. The overall percentage of deer and elk muzzle-loader and archery tag-holders is presented in table 1. The CVM portion of the survey was repeated in February 1984; it collected information on the 1983 elk hunting season.

The survey was designed to collect information on elk hunting trips made during the hunting season,[3] e.g., hunt unit visited, number of animals seen, and number of licensed hunters in party. For the Travel Cost Model analyses, trips were screened to insure hunting was the primary purpose and that visitation of that particular site was the primary destination of the trip. The intent was to eliminate from the TCM analyses multidestination and multipurpose visits that were not dependent on the availability of hunting. The CVM bidding question was asked for each trip to estimate the value of each trip made during the hunting season.

In the CVM portion of the survey on the 1982 season, respondents were asked if the trip was worth more to them than they actually paid. If they gave a specific amount, this value was recorded. When the respondent was hesitant to express a value, the interviewer increased the value in increments of 10% until a maximum was reached. This final value was recorded. This method of eliciting bids combines the open-end and the iterative bidding procedures. When the respondent could not put a dollar value on the worth of the trip or indicated an infinite value, the bid was not used in data analysis. If the respondent said the trip was not worth more, no protest question was asked. As a result some of the zero bids used in data analysis represent a protest against the question and not a zero value of the elk hunting resource.

The CVM portion of the survey was repeated in 1984 for the 1983 hunting season in order to implement a single bidding technique. In this survey respondents were asked if the trip was worth more. If they responded yes, an iterative bidding technique starting with a 25% increment was implemented. The value was increased in increments of 10% until the final bid was elicited and recorded. This later survey included a protest question

[3] *The questionnaire related to economic data, developed by Lou Nelson and Lloyd Oldenburg of the Idaho Department of Fish and Game, was implemented in conjunction with the Big Game Harvest Survey. The economic portion of the survey was revised using feedback provided by John Hof, Thomas Hoekstra, Terry Raettig, Wendall Beardsley, and Cindy Sorg of the USDA Forest Service and John Loomis of the USDI Fish and Wildlife Service. A copy of the survey of big game hunting units is contained in the appendix.*

Table 1.—Sampling rate for economic survey of elk hunting in Idaho, 1983.

Tag type	Number sold	Number of hunters contacted	Percent of tag holders surveyed
Rifle resident	50,240	11,112	2.21
Resident Panhandle	14,625	323	2.21
Senior resident	3,708	5	.14
Nonresident	7,301	159	2.18
Nonresident Panhandle	1,119	30	2.50
All elk[1]	77,073	1,629	2.11
Archery elk	15,594	42	1.58
Muzzle-loader	6,791	255	3.76

[1] *Figures do not include archery or muzzle-loader hunters.*

to allow for differentiating between legitimate zero bids, which were recorded, and zero bids made in protest to the survey itself, which were not used. In addition, this later survey asked willingness to pay for double number of elk seen.

For both years, information on the number of days hunted on this trip and the number of hours hunted per day was also recorded. This was used to convert TCM and CVM dollar values to a value per day and also a value per 12-hour WFUD.

Confidence intervals around the TCM estimate of net willingness to pay cannot be estimated directly because of aggregation and statistical operations applied to the data. The appendix shows a method by which sensitivity intervals can be estimated around the TCM distance coefficient of net willingness to pay. For a complete discussion of the Travel Cost Method, refer to Clawson and Knetsch (1966) or Dwyer et al. (1977).

STATISTICAL ANALYSIS

Travel Cost Method

Analysis of the travel cost data progressed in the following manner. To be able to derive visits per capita, the individual cases were grouped according to counties or in some cases county groups. Within the state of Idaho and bordering counties, county-level specification was used. For bordering states with nonbordering counties, county groups were developed. Beyond this level, state and state groups were specified. By dividing population into trips for a state or county group, trips per capita from each group of visitor origin could be calculated. Mean per capita income was also calculated for each group. Once the data were aggregated, measures of substitute site attractiveness and site quality were calculated using data collected in the survey or data contained in the harvest report.

Several site quality measures were formulated to reflect hunting quality.[4] Total harvest in 1981 was used as the significant variable in the regression analysis because it was felt many hunters would plan 1982 elk hunting trips based on success in the 1981 hunting season. Total harvest in an area may be considered a measure of possible success at a site and, therefore, a reflection of quality at a site.

Two methods for measuring substitute sites were tested, both modeled after Knetsch et al. (1976). Their substitute term has attractiveness of substitute site in the numerator and distance to the substitute site in the denominator. In this study, attractiveness was correlated with total harvest. Any site K was considered a substitute for site J if the ratio of harvest to distance from origin L to site K was greater for site K than site J's ratio. That is, site K would be a cost-effective substitute because it had a higher harvest per mile driven than the site J under study. Therefore, both quality and cost (distance) of alternative sites were considered in determination of what sites were substitutes for others. The first substitute considered only that site with the highest ratio relative to the site in question. That is, the most effective substitute site J relative to the given site K.

The second substitute measure was the sum of the quality index for all sites having a higher harvest per mile than the site under study. Because analysis was limited to data collected in the survey, only sites with actual visits by at least one hunter were considered as potential substitutes.

No measure of substitutes was found significant in the regression analysis, indicating benefit estimates are an overestimate or underestimate of consumer surplus. The magnitude of the effect on value estimation that results from not including a substitute measure is not known. As discussed in Caulkins et al. (1983), there are two possible effects of not including a substitute term. If the substitute and distance variables are positively correlated, the omission of substitutes would bias the benefit estimate downward whereas the value estimate would be biased upward. The sign of the bias on the value estimate is not known.

Mean per capita personal income for county/state groups was also tested as a variable because economic theory indicates income influences ability to purchase trips to a recreation site. Income entered strongly into the analysis with a negative coefficient, possibly indicating elk hunting is an inferior good. This term does not imply inferior in quality or in any social sense; it merely refers to the relationship between quantity demanded and income. Without specific income and hunting preference data for each respondent, it is not possible to determine the degree, if at all, to which elk hunting can be considered an "inferior good" relative to other more expensive and time-consuming recreational activities such as bighorn sheep or mountain goat hunting.[5] It is also possible that as income rises, a different form of elk hunting is demanded, such as limited hunt permits in remote areas that involve a longer hunt using more specialized and expensive equipment.

Regression Analysis

In performing the regression analysis, choices regarding functional form and inclusion of variables became obvious as the analysis progressed. The variables that were consistently insignificant were generally dropped from further consideration. The issue of functional form is not so easy to determine. Several models are proposed in the literature.

Ziemer et al. (1980), Vaughan and Russell (1982), and Strong (1983) argue that because of the pattern by which trips per capita falls off at greater distances, the natural log of visits per capita is preferred to either a linear func-

[4]Those site quality variables tested but found to be insignificant in regression analysis included total animals seen, hunters per square mile in 1981, harvest per square mile, total animals seen per day, average number of days hunted, average number of hours hunted, and hunter days per square mile.

[5]Goods for which purchases rise with income are "normal goods." Goods for which purchases fall as income rises are called "inferior goods."

tional form or natural log of distance. Their point is that either of the latter two functional forms will predict negative visits for a few high-cost origins. Negative visits are contrary to intuition and, thus, the natural log of visits per capita functional form is preferable.

Bowes and Loomis (1980) argue that unequal sizes of population groups require a weighting factor that is the square root of population to avoid heteroskedasticity (heterogeneous variances), thereby improving both benefit and use estimates. Vaughan and Russell (1982) and Strong (1983) show that if the log of visits per capita is chosen as the functional form, heteroskedasticity will be so greatly reduced that weighting by square root of population may be unnecessary.

Both methods were tested in this study. A judgment criterion involved comparing estimated visits to actual sampled visits. If estimated visits were fairly close to actual visits, the natural log of visits per capita was used rather than Bowes-Loomis weighting, which provides exact use estimation of predicted visits and sampled visits. The settlement of this trade-off depends on whether use or benefit estimation is the critical factor of the study objective. In this study, benefit estimation was most critical.

Calculation of TCM Benefits

To calculate benefits with distance as the price variable using the second stage demand curve approach, distance must be converted to dollars. Travel costs to a site consist of transportation costs and travel time costs. Travel time is included because, other things remaining equal, the longer it takes to get to a site, the fewer visits will be made. That is, time, because it is often a limiting factor, acts as a deterrent to visiting more distant sites. Omission of travel time will bias the benefit estimates downward (Cesario and Knetsch 1970, Wilman 1980).

The value of travel time was set at one-third of the wage rate as prescribed by the U.S. Water Resources Council (1979, 1983). This is the mid-point of values of travel time that Cesario (1976) found in his review of the transportation planning literature. However, the use of one-third the wage rate is not necessarily intended to measure wages forgone during the time spent traveling, but rather the deterrent effect of scarce time on which hunt units to visit. Because direct data on hunter income were not collected, this study used the U.S. Department of Labor's estimate of a median wage of $8.00 per hour. One-third of this is $2.67 per hour, so an average opportunity cost of time spent traveling was about $0.67 per mile.

Conversion of round-trip mileage to transportation costs progressed in three steps. First, mileage was converted to transportation cost on a per vehicle basis using the variable automobile costs from the U.S. Department of Transportation (1982). An intermediate-size car class was taken as typical, at a cost of $0.135 per mile in 1982. A mileage figure for pickup trucks was not reported. Second, with approximately 2.7 hunters per vehicle, this standard cost per person was approximately $0.05 per mile.

Finally, the transportation cost also was estimated using the cost per mile reported by survey respondents rather than the standard cost per mile of $0.135. Respondents reported their own trip transportation costs which, when divided by round-trip distance, equaled approximately $0.313 per mile or $0.12 per mile per hunter. This may be a more appropriate value to use because it is the price perceived by the respondent. That is, the quantity of trips consumed would probably be more closely related to the perceived cost rather than some standardized cost. Additionally, the Department of Transportation figure used reflected costs of suburban driving with an intermediate size car. Elk hunting may often involve use of a four-wheel-drive pickup, often with a camper shell. Roads traveled would rarely resemble suburban driving. These considerations would raise the transportation costs above that of an intermediate-size car. The net effect is to now associate the quantity of trips made with a higher price per trip ($0.05 vs. $0.12), which translates into a rightward shift in the upper portion of the second stage demand schedule. This shift results in an increase in total and, therefore, per trip consumer surplus. To provide the most useful information for valuation of Idaho elk hunting and to allow comparison to other studies, net willingness to pay is calculated and presented in the results using both standardized and reported cost. For a given increment in distance or added miles, the transportation cost and value of travel time for the amount of time required to travel that distance increment is added together. This rescales the vertical axis of the second stage demand curve from miles to dollars. The area under the second stage demand curve yields estimated consumer surplus for the sample.

Contingent Value Method

The mean net willingness to pay was calculated once missing values, outliers, and infinite bids were removed. Consider first the data collected in 1983 for the 1982 hunting season. When asked if a trip was worth more, 88.8% indicated yes. Any bid greater than $1,000 was screened as a possible outlier. This involved looking at the respondent's origin, hunt unit visited, number of hours hunted, and number of days hunted. Based on these variables, a subjective decision was made as to the validity of the bid. Of the seven bids over $1,000, three were judged to be invalid. These bids were more than $6,000 for a two-day trip. The bids reported in the results section may be an underestimate of true value because 39.5% of respondents placed an infinite value on elk hunting at the site they hunted. If these individuals could have been questioned further and a value elicited, the result may have been to increase the overall mean. Further, for elk hunting in Wyoming, Sorg (1982) found a significant difference between initial bids and final iterative bids, indicating those bids obtained without using the iterative bidding procedure may be an underestimate of true value.

A CVM iterative bidding technique was used in 1984 to collect willingness to pay information for the 1983 elk

hunting season. No outliers were found for willingness to pay for current conditions or willingness to pay for double the number of elk seen per trip. The trip was worth more to 91.5% of the respondents. In addition, use of an iterative bidding procedure resulted in only 6% of the respondents placing an infinite bid on hunting at the site in question. The willingness to pay bids reported for the 1983 season are, therefore, more reliable.

Data collected on number of animals seen on the trip were used to segregate individual bids into groups; in this study, bids were separated into the following groups: 0 elk, 0–5, 5–10, 10–15, 15–20, 20–30, 30–40, 40–50, 50–100, and more than 100 elk. This gave an indication as to whether bids vary by number of elk seen.

RESULTS AND DISCUSSION

Table 2 presents a summary profile of the data collected in the hunter survey for the TCM and CVM analyses. These mean values will be used in discussions and tables throughout the remainder of the report to convert net willingness to pay per trip to standard accounting measures such as net willingness to pay per day or per WFUD.

Figure 3 presents an elk hunt unit map that shows the type of season available in each hunt unit. This map will prove useful when differentiating values across units. For example, in the Panhandle area a general rifle permit allows hunting for both antlered and nonantlered elk. All other areas in the state allow antlered hunting only. Also notice the units that permit only archery hunts. The values for these sites as compared to general rifle season may prove useful to management.

Travel Cost Method

As discussed earlier, choice of functional form of the per capita demand equation was related to how well the log of visits per capita reduced heteroskedasticity. The weighted regression equation resulted in neither substitutes nor quality measures being statistically significant. The log of visits per capita did minimize heteroskedasticity to the extent that estimated visits to the hunting units were 2,851 while actual visits were 3,636. The estimated visits were within 25% of the actual. For building a Regional Travel Cost Model for valuation of different hunt areas, it may be more important to have quality and income variables present in the equation rather than to sacrifice them to improve the use estimate.

The regression equation used to calculate benefits for elk hunting is given in equation [2]:

$$\begin{array}{lll} & \ln(\text{Trpcap}) = -3.1102 & -0.0016\text{Dist} \\ \text{"t" statistics} & (-7.13) & (-24.12) \\ & -0.0009924\text{Inc} & +0.001049\text{Tharv} \\ & (-14.09) & (3.45) \end{array} \qquad [2]$$

where

Trpcap = total trips per capita
Dist = round-trip distance in miles
Inc = county (group) mean per capita income
Tharv = total harvest in hunt unit for 1981.

This equation is highly significant overall with an F-value of 398.33 and an R^2 value of 0.69.

The model specified in equation [2] is termed log-linear because the dependent variable is transformed as shown and the independent variable associated with cost, i.e., distance, is not transformed.

As discussed earlier, no measure of substitute sites was found significant in the regression analysis. While total harvest in 1981 proved significant in measuring quality at a particular unit, a measure of this variable does not provide a measure of what constitutes a substitute unit. For example, two equally distant units with the same total harvest may not be substitutes because one has a much later season or one does not have a developed camping area. Therefore, while total harvest does play a significant role in measuring quality at a unit, it does not show how hunters substitute across sites. Data outside this set may provide this information. Variables that could provide a measure of substitutes may include geographic characteristics, family tradition, or remoteness. Without a measure of substitute units, the values reported here are an overestimate or underestimate of elk hunting consumer surplus. How much of an overestimate or underestimate is not known. The TCM

Table 2.—Elk hunter profile.

	1983		1984	
	Mean	Sample Size	Mean	Sample Size
Number of elk seen per trip	4.50	3862	8.98	335
Number of hunters per vehicle	2.70	3860	3.12	424
Number of days hunted per trip	2.84	3862	4.10	426
Number of hours hunted per day	7.05	3862	7.46	426
Round-trip distance	244.16	3862	—	—
Total expenditures	$76.47	3862	—	—
Dollars spent on travel	$37.73	3862	$92.33	423
Dollars spent on food	$22.47	3862	$84.02	406
Dollars spent on accommodations[1]	$42.60	102	$86.22	56
Dollars spent on guides[1]	$1026.68	57	—	—

[1] *Only those people using the service entered into calculation of the mean.*

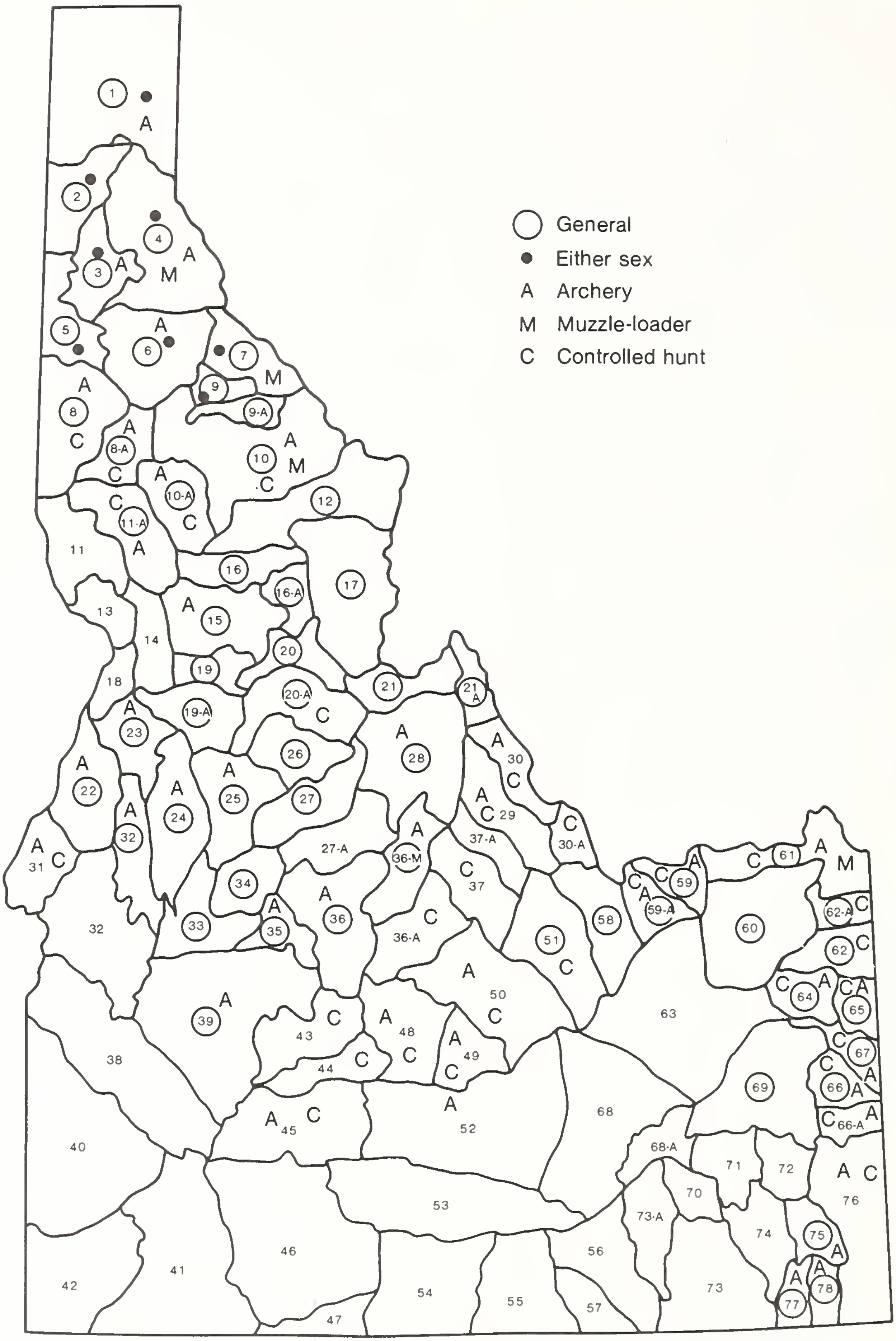

Figure 3.—Map of Idaho elk hunting units showing season permit types for 1983

values can be compared to the CVM values as an indication of the direction and magnitude of the bias. If the 1982 and 1983 seasons are similar, the 1983 CVM values may be the most representative because they were collected using standard methodology. The sensitivity intervals discussed below provide a range of values to consider.

The resulting per capita demand curve was used to derive a second stage demand curve for each elk hunting unit. The second stage demand curve was calculated for each hunt unit using the total harvest in 1981 as the quality measure and mean county (group) per capita income. Successive 100-mile increments were added to the distance variable until visits per capita from a particular origin were reduced to 0.1 or until distance equaled the highest regularly observed distance in the data. The highest regularly observed distance was a 5,000-mile round-trip from Florida. This occurred in five cases. This distance limit was used as a cutoff because, with natural log of visits per capita, visits would never drop to zero. This procedure of using highest observed distance as an upper limit was used first by Wennergren (1967) and since then by others (Smith and Kopp 1980). This rule yields a conservative estimate of the surplus because it cuts off a portion of consumer surplus; however, in this application only five areas had an added distance greater than 5,000 and therefore little consumer surplus was lost.

Figure 4 illustrates the second stage demand curve for the most heavily visited unit, unit 4, in the Panhandle region. Because the distance increment is over and above current distance, the entire area under this curve (when distance is converted to dollars) is consumer surplus. A simple conversion of the added distance to dollars cannot be made on the graph because the conversion of

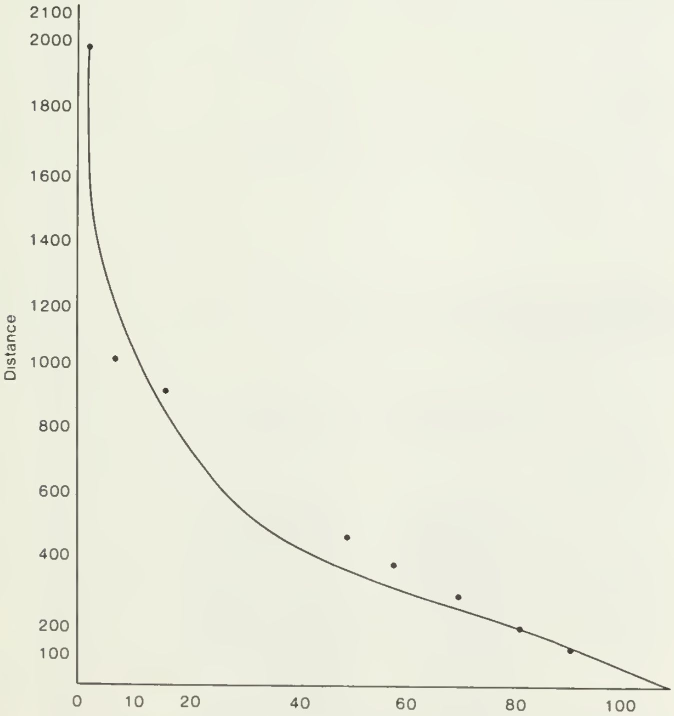

Figure 4.—Second stage demand curve for unit 4, Panhandle region

distance to travel cost for a given site was made origin by origin to account for differences in the number of hunters per vehicle. The unit total consumer surplus of those 2.1% individuals sampled is $7,327.79 using the standard cost of $0.135 per mile. Putting this on a per trip basis gives a value of $64.90. With the reported transportation cost of $0.313 per mile, the unit consumer surplus of those 2.1% sampled is $11,472.22, yielding a consumer surplus per trip of $101.61.

Table 3 reports average TCM values over all hunting units. These values represent the average value for an elk hunting trip to an average unit in the state, not the average value for elk hunting in the state as a whole (i.e., the value of a trip to an average unit with all other units available).

Contingent Value Method

Table 4 reports average CVM values over all hunt units. As with the average TCM value, the CVM average state value is willingness to pay for an average unit in the state with all other units available, not average willingness to pay for elk hunting in the state as a whole. If the elk hunting seasons for 1982 and 1983 are nearly identical, the difference in trip values can be explained by the open-ended iterative technique and high infinite bid response rate found in 1982. Alternatively, changes in management or increased hunting success or improved quality in the 1983 elk hunting season may be reflected in the 1983 value. On a per day basis, the values are much closer. Because no major changes were made in elk season management, it is assumed that differences in techniques and infinite bid response rates account for the discrepancies. As a result, the 1983 values are more theoretically correct.

In addition to asking a willingness to pay for current conditions, the survey for the 1983 season asked willingness to pay if the individual could expect to see double the number of elk per trip. Respondents indicated a willingness to pay $149.39 per trip for doubling the number of elk seen. This is a useful tool to management. Even though elk hunters can only bag one animal, they still prefer to see more elk per trip. Perhaps seeing more elk gives more choice as to which one to kill or merely adds to the trip enjoyment.

To show a trend in willingness to pay bids, hunters were grouped according to number of elk seen per trip. These bids are shown on table 5. In general as number of elk seen increased, willingness to pay also increased. This is especially true for 0–15 elk and generally true for more than 15 elk. Hunters may have a threshold of the number of elk they would like to see on a trip, and may not be willing to pay more above this threshold. Obviously the threshold level varies across hunters, but the general trend shown in table 5 should be useful to managers.

Comparison of TCM and CVM Values

Comparison of TCM and CVM values will focus on trip values to allow comparison of state average values and

Table 3.—Average elk hunting values from the Travel Cost Method.

	Standard cost per mile[1]	Reported cost per mile[2]
Net willingness to pay per trip for current conditions	[3]$63.17	[4]$99.82
Number of days hunting per trip	2.84	2.84
Net willingness to pay per day for current conditions	$22.26	$35.18
Number of hours hunted per day	7.05	7.05
Net willingness to pay per WFUD for current conditions	$37.88	$59.87
Expenditures per trip	$76.47	$76.47

[1]*Standard cost per mile of $0.135.*
[2]*Reported cost per mile of $0.313.*
[3]*Sensitivity interval: $57.86 to $69.40.*
[4]*Sensitivity interval: $89.67 to $111.52.*

Table 4.—Average elk hunting values from the Contingent Value Method.

	1982	1983
Net willingness to pay per trip for current conditions	$52.84[1]	$92.54[2]
Number of days hunting per trip	2.84	4.10
Net willingness to pay per day for current conditions	$18.25	$22.57
Number of hours hunted per day	7.05	7.46
Net willingness to pay per WFUD for current conditions	$31.06	$36.31
Number of animals per trip	—	8.98
Net willingness to pay per trip for double number of elk seen	—	$149.39

[1]*95% Confidence interval: $45.44 to $58.24.*
[2]*95% Confidence interval: $72.31 to $112.78.*

Table 5.—CVM average elk hunting values based on number of elk seen per trip. (Numer of respondents in parentheses)

Number of elk seen per trip	Net Willingness to pay per trip 1983		1984	
0	$ 29.24	(735)	$ 49.88	(86)
1-5	52.02	(554)	70.19	(133)
6-10	$ 65.12	(199)	130.85	(41)
11-15	104.86	(91)	191.82	(22)
16-20	93.64	(36)	120.91	(11)
21-30	113.75	(36)	193.85	(13)
31-40	204.69	(13)	181.79	(14)
41-50	76.67	(15)	139.29	(7)
51-100	321.89	(9)	578.57	(7)
>100	156.40	(5)	1000.00	(1)

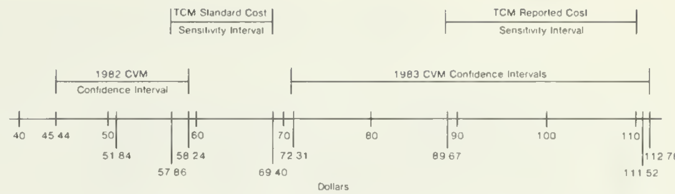

Figure 5.—Comparison of TCM and CVM dollar value estimates for elk hunting

region average values. Figure 5 presents a graphic comparison of the mean state TCM and CVM values and their associated sensitivity and confidence intervals. The mean 1983 CVM willingness to pay value for the 1982 season is $51.84 with a 95% confidence interval from $45.44 to $58.24. The mean 1983 CVM willingness to pay value is $92.54 with a 95% confidence interval from $72.31 to $112.78. The mean TCM willingness to pay using standard cost is $63.17 with a sensitivity interval of $57.86 to $69.40. Using reported cost, the mean TCM willingness to pay is $99.82 with a sensitivity interval of $89.67 to $111.52. The reported cost TCM sensitivity interval crosses the 1984 CVM confidence interval indicating the two measures are comparable.

Collection of the 1982 CVM data utilized a combination of open-ended and iterative survey design. While not conclusive, studies (Rahmatian 1982 and Sorg 1982) indicate use of an open-ended survey format may result in an underestimate of maximum willingness to pay. The results of the 1983 survey substantiate this conclusion. Also, in reference to the 1982 season CVM survey design, a disproportionately larger number of respondents (39.5%) indicated an infinite bid and, therefore, were not included in estimating the overall mean willingness to pay. Only 6% placed infinite bids in 1983. The combination of noniterative and infinite bids may have resulted in the 1982 CVM value being an underestimate of true willingness to pay. The 1983 CVM values are more theoretically correct.

An important variable in the TCM regression analysis is a substitute site term. This variable shows the effect on a particular site value when there are other sites that could be visited in place of that site. For some hunting activities, such as bighorn sheep, there may not be substitute sites or substitute site may be so few that their effect on value is negligible. In the case of the Idaho elk hunting where there are at least 40 other sites available as alternatives to a particular site, not including a substitute term in the regression may result in an overestimate or underestimation of value. Several substitute variables were tested; however, none was found significant in the regression analysis. As a result, the TCM reported cost values may be an overestimate or underestimate of willingness to pay.[6] However, in this study TCM and CVM values are theoretically equivalent; therefore, the values measured by each should be similar. This is the case, based on confidence and sensitivity interval comparisons, which indicates omission of the substitute term has not greatly biased TCM value estimation.

Table 6 reports TCM and CVM values by region, area, and unit, as defined by Idaho Department of Fish and Game Elk Species Management Plan (1980).[7] The value for each unit is conditioned by the fact that it is part of a system of all other units. That is, the value at one unit is contingent on the availability of all other units. When comparing across units, it is more reliable to compare across areas or regions rather than individual units because, at the individual unit level, unit-specific data has a smaller sample size and, therefore, a larger degree of error. For example, the two regions with the highest TCM values are regions 1 and 6. Region 1 is the only region with an either sex hunt and, as the results indicate, this a more highly valued resource.

CVM values by hunt unit, area, and region in table 6 show that for 1982, region 6 has the highest value, followed by region 2. For 1982, regions 3 and 2 have the highest values.

Human population centers are located in the southwest portion of the state, therefore the most accessible hunting is located in region 3. The close proximity to human populations while still not within these centers translates into a highly valued resource. Because the cost of obtaining the resource is low, benefits are high. A more remote elk hunting resource is found in region 2. The remoteness of this region may be more important to some hunters; therefore, the high value reflects this factor rather than the accessibility factor.

Comparison to Other Elk Studies

Hansen[8] (1977) utilized CVM to derive the value of elk hunting in a region comprising Idaho, western Wyoming, Utah, and Nevada. Data were taken from the 1975 U.S. Fish and Wildlife Service Hunting and Fishing Survey. The mail survey format was noniterative and open-ended. Respondents were asked how much more they would be willing to spend before not engaging in elk hunting. A value of $22.63 per visitor day is reported. Adjusted to 1982 this value is $36.37. Except for the mail format, the survey technique used by Hansen is similar to this study. Hansen's value is lower; however, it is a regional value that includes Utah and Nevada. If elk hunting in Idaho is of higher quality when compared to Utah and Nevada, the difference in values is explained. Further, use of a noniterative bid format may account for the lower value.

Sorg (1982) measured the value of elk hunting in Wyoming utilizing CVM. The survey was in-person iterative and asked willingness to pay additional expenditures before forgoing elk hunting at the hunt unit in question. A value of $92.00 per day for resident hunters is reported. This value is similar to the reported cost TCM value and the 1983 CVM value and slightly larger than the 1982 CVM value. This would indicate Wyoming and Idaho offer a similar resource or attract a similar

[6] *It should be noted that this discussion has no effect on the choice between reported and standard cost per mile, which is a separate issue.*

[7] *Idaho Department of Fish and Game. 1980. Elk, 1981-1985. Species Management Plan. 91 p.*

[8] *Hansen, Christopher. 1977. A report on the value of wildlife. Intermountain Region, U.S. Forest Service, Ogden, Utah. December 1.*

Table 6.—Average elk hunting values from TCM and CVM by region, area, and unit. (Sample size in parentheses)

Hunting site—Area Unit	Travel Cost Method		Contingent Value Method			Average total cost/hunter-trip						Average no./hunter-trip			
	Standard cost/mile NWTP	Reported cost/mile NWTP	1983 NWTP for current conditions	1984 NWTP for current conditions	1984 NWTP for double no. elk seen	Total cost	Travel	Food	Motel	Guide	Sample size	Elk seen/trip	Hunters/vehicle	Days hunting	Hours/day hunting
			REGION 1												
Area 1															
1	$57.57	$86.50	$27.38 (21)	$38.00 (5)	$57.00 (5)	$16.49	$10.86	$5.63	-	-	99	0.82	1.78	2.25	5.10
2	51.28	78.28	0 (4)	-	-	12.42	9.63	2.79	-	-	19	3.11	2.56	2.74	5.32
3	56.32	91.60	11.33 (43)	26.11 (9)	28.88 (9)	21.58	16.08	5.50	-	-	78	1.35	2.55	2.45	7.00
5	39.10	59.34	33.00 (1)	23.33 (3)	60.00 (3)	34.54	15.36	19.18	-	-	11	2.82	3.00	1.64	6.18
Total	54.26	83.29	15.87 (69)	29.12 (17)	42.65 (17)	18.99	12.95	6.04	-	-	207	1.34	2.21	2.34	5.89
Area 2															
4	64.90	101.61	21.21 (225)	87.71 (24)	103.96 (24)	30.51	17.62	12.83	28.00 (1)	-	456	1.39	2.71	2.15	6.66
6	62.82	95.24	21.21 (102)	122.22 (18)	152.77 (18)	29.85	18.74	11.04	20.00 (1)	-	289	0.88	2.78	2.26	6.47
7	69.22	117.69	69.98 (45)	133.33 (12)	270.61 (11)	105.27	54.69	45.13	75.00 (1)	350.00 (1)	78	2.45	3.21	5.06	7.26
9	82.57	60.96	286.38 (8)	-	-	186.77	71.77	61.15	-	700.00 (1)	13	3.31	3.23	5.54	6.77
Total	68.36	109.54	32.57 (380)	109.35 (54)	155.58 (53)	39.68	22.31	15.97	41.00 (3)	525.00 (2)	836	1.34	2.79	2.51	6.65
TOTAL	66.55	106.16	30.00 (449)	90.14 (71)	128.43 (70)	35.67	20.45	14.00	41.00 (3)	525.00 (2)	1043	1.34	2.67	2.48	6.50
			REGION 2												
Area 1															
8	48.04	74.53	14.73 (96)	-	-	14.30	10.65	3.65	-	-	170	0.67	2.30	1.57	7.19
8-A	37.84	60.96	21.76 (37)	9.44 (9)	36.57 (9)	24.35	15.36	8.99	-	-	108	1.90	2.21	1.95	6.57
9-A	97.73	183.89	38.00 (2)	-	-	258.34	151.67	106.67	-	-	3	4.33	2.33	4.33	5.67
10	57.21	84.27	57.84 (141)	172.67 (30)	239.50 (30)	84.73	40.53	22.88	29.50 (14)	1055.37 (7)	366	5.56	2.88	3.18	6.53
10-A	67.58	107.12	13.71 (45)	33.75 (4)	122.50 (4)	29.33	18.91	10.42	-	-	114	2.48	2.50	2.01	6.78
12	63.93	103.30	326.31 (42)	60.00 (16)	87.80 (15)	286.64	109.63	68.29	34.90 (10)	959.71 (7)	65	8.31	2.91	6.17	7.31
15	53.29	83.73	46.49 (69)	97.50 (10)	151.00 (10)	65.14	35.96	18.42	56.80 (5)	852.50 (2)	185	5.11	2.66	2.91	7.09
16	64.97	102.26	153.55 (11)	85.00 (4)	127.50 (4)	207.05	91.39	42.89	15.50 (2)	930.50 (2)	26	4.23	3.00	4.27	7.27
Total	60.69	95.11	66.97 (443)	105.14 (73)	157.01 (72)	73.54	35.75	19.71	34.74 (31)	981.85 (18)	1037	4.09	2.64	2.83	6.84
Area 2															
11-A	58.15	80.24	29.50 (2)	40.00 (1)	50.00 (1)	18.86	11.07	7.79	-	-	14	1.43	1.57	1.57	2.79
Area 3															
16-A	45.20	61.83	130.36 (11)	125.00 (4)	200.00 (4)	453.94	91.39	42.89	16.00 (3)	676.67 (3)	18	4.23	3.00	4.27	7.27
17	48.82	71.12	297.77 (31)	175.33 (15)	302.33 (15)	665.02	247.02	139.05	24.58 (12)	1013.55 (11)	41	4.76	3.51	7.37	8.20
19	55.01	83.05	68.20 (5)	50.00 (1)	75.00 (1)	162.90	105.80	49.10	80.00 (1)	-	10	5.00	2.70	5.20	8.10
20	54.42	84.94	148.57 (7)	610.00 (3)	1110.00 (3)	383.51	149.38	99.13	80.00 (1)	500.00 (2)	8	7.25	3.25	12.13	6.63
Total	54.43	76.80	223.07 (54)	217.83 (23)	380.00 (23)	512.31	216.66	113.94	29.59 (17)	886.25 (16)	77	5.71	3.34	7.13	7.91
TOTAL	57.83	86.76	83.72 (499)	129.50 (109)	204.91 (108)	103.42	47.79	25.99	32.92 (48)	936.86 (34)	1128	4.17	2.67	3.12	6.86

Table 6.—Average elk hunting values from TCM and CVM by region, area, and unit.—Continued

Hunting site—Area Unit	Travel Cost Method: Standard cost/mile NWTP	Travel Cost Method: Reported cost/mile NWTP	Contingent Value Method: 1983 NWTP for current conditions	Contingent Value Method: 1984 NWTP for current conditions	Contingent Value Method: 1984 NWTP for double no. elk seen	Average total cost/hunter-trip: Total cost	Average total cost/hunter-trip: Travel	Average total cost/hunter-trip: Food	Average total cost/hunter-trip: Motel	Average total cost/hunter-trip: Guide	Sample size	Average no./hunter-trip: Elk seen/trip	Average no./hunter-trip: Hunters/vehicle	Average no./hunter-trip: Days hunting	Average no./hunter-trip: Hours/day hunting
REGION 3															
Area 1															
19-A	56.55	92.86	42.61 (18)	105.00 (4)	130.00 (4)	64.82	40.27	24.55	-	-	33	2.09	2.82	3.61	6.94
20-A	61.46	96.74	296.00 (15)	705.00 (6)	1126.67 (6)	882.33	276.86	115.57	50.77 (9)	1228.88 (8)	21	11.38	3.00	6.52	8.86
25	59.23	96.41	32.84 (37)	125.00 (4)	135.00 (4)	53.57	31.80	21.39	25.00 (1)	-	66	1.64	2.50	2.59	7.41
26	44.53	65.16	313.70 (10)	56.67 (6)	245.00 (6)	412.69	111.50	52.81	37.00 (2)	1950.00 (2)	16	25.81	3.19	7.69	7.69
Total	57.09	90.24	119.49 (80)	274.50 (20)	464.50 (20)	226.52	81.07	40.40	84.42 (12)	1373.10 (10)	136	6.10	2.74	4.04	7.55
Area 2															
22	87.17	157.05	13.96 (27)	42.00 (5)	56.00 (5)	57.40	34.82	22.58	-	-	33	3.18	2.33	2.49	7.06
23	51.78	80.46	32.70 (10)	162.50 (4)	362.00 (4)	34.89	16.89	18.00	-	-	26	6.39	3.00	2.81	7.73
24	58.16	91.78	30.14 (36)	36.00 (5)	104.00 (5)	42.49	23.49	18.35	21.00 (2)	-	65	3.92	2.62	2.37	6.86
31	64.54	102.56	12.25 (4)	-	-	46.66	31.83	14.83	-	-	6	2.67	2.50	3.00	8.00
32-A	64.40	107.35	13.40 (5)	41.67 (3)	83.33 (3)	28.91	17.23	11.68	-	-	22	2.77	2.23	2.09	6.77
33	69.21	116.53	41.73 (11)	25.00 (3)	35.00 (3)	39.48	22.91	16.57	-	-	21	2.76	2.71	3.48	8.00
34	75.46	131.46	18.67 (6)	230.00 (5)	249.00 (5)	63.63	44.13	19.50	-	-	16	7.13	2.50	3.56	7.81
35	48.41	67.02	72.33 (3)	75.00 (2)	130.00 (2)	177.33	96.33	56.00	75.00 (1)	-	3	0.33	3.00	4.67	6.00
39	59.64	94.59	45.78 (37)	63.33 (9)	101.11 (9)	35.34	20.68	14.66	-	-	87	4.67	2.47	2.21	7.49
Total	65.98	109.35	31.56 (139)	86.39 (36)	153.33 (36)	42.77	24.95	17.40	39.00 (3)	-	279	4.24	2.55	2.54	7.31
TOTAL	62.77	102.44	63.68 (219)	155.83 (54)	273.70 (54)	102.99	43.34	24.94	75.33 (15)	1373.10 (10)	415	4.85	2.61	3.03	7.39
REGION 4															
Area 2															
(48)	0	0	6.00 (1)	-	-	6.00	3.00	3.00	-	-	1	0	1.00	1.00	10.00
Area 3															
(49)	55.85	85.44	1.00 (1)	-	-	13.00	8.00	5.00	-	-	1	0	3.00	1.00	5.00
Area 4															
45	46.27	76.95	-	-	-	30.00	20.00	10.00	-	-	1	0	2.00	2.00	7.00
52	48.49	75.31	20.43 (7)	-	-	23.57	8.57	15.00	-	-	7	38.86	2.86	1.86	7.00
TOTAL	50.10	78.32	16.67 (9)	-	-	21.40	9.10	12.30	-	-	10	27.20	2.60	1.70	7.10
REGION 5															
Area 2															
66-A	50.68	72.10	148.00 (7)	30.00 (4)	52.50 (4)	123.20	75.50	47.70	-	-	10	5.70	3.90	4.10	8.00
76	48.76	81.35	8.75 (4)	22.50 (4)	36.25 (4)	25.27	16.40	8.87	-	-	15	2.33	1.80	1.27	5.27
75	57.19	92.13	40.88 (25)	10.00 (2)	43.50 (2)	30.46	20.33	10.13	-	-	39	3.26	2.77	1.54	7.36
77	56.92	84.22	19.00 (7)	10.00 (1)	20.00 (1)	12.23	7.36	4.87	-	-	31	1.84	5.13	1.26	7.36
78	34.51	50.68	525.00 (1)	43.33 (3)	43.33 (3)	51.86	23.29	28.57	-	-	7	6.29	2.57	4.14	7.14
TOTAL	53.26	81.55	62.52 (44)	24.69 (16)	38.56 (16)	34.71	21.42	13.29	-	-	102	3.14	3.44	1.84	7.10

Table 6.—Average elk hunting values from TCM and CVM by region, area, and unit.—Continued

Hunting site—Area Unit	Travel Cost Method		Contingent Value Method			Average total cost/hunter-trip						Average no./hunter-trip			
	Standard cost/mile NWTP	Reported cost/mile NWTP	1983 NWTP for current conditions	1984 NWTP for current conditions	1984 NWTP for double no. elk seen	Total cost	Travel	Food	Motel	Guide	Sample size	Elk seen/trip	Hunters/vehicle	Days hunting	Hours/day hunting
			REGION 6												
Area 1															
21	53.21	82.68	141.11 (9)	71.88 (8)	90.63 (8)	124.03	67.31	48.59	130.00 (2)	-	32	12.28	2.41	3.94	3.69
21-A	72.90	126.02	99.80 (10)	134.00 (5)	154.00 (5)	86.72	44.23	25.71	20.00 (1)	500.00 (1)	31	6.00	2.81	3.65	7.42
28	50.93	79.14	43.11 (27)	30.00 (5)	30.00 (5)	58.49	32.56	20.12	110.33 (3)	-	57	3.79	2.14	2.67	6.68
36	63.69	106.60	485.00 (31)	283.33 (3)	373.00 (3)	87.00	50.91	35.83	14.00 (1)	-	54	2.48	2.32	3.54	7.98
36-B	55.45	83.13	202.00 (10)	43.75 (8)	56.25 (8)	80.77	48.07	31.22	40.00 (1)	-	27	2.67	2.44	3.74	8.00
Total	60.44	98.25	235.48 (87)	89.48 (29)	110.86 (29)	83.93	46.91	31.23	83.13 (8)	500.00 (1)	201	4.98	2.37	3.40	7.32
Area 2															
29	38.49	63.65	-	0 (1)	0 (1)	28.33	17.33	11.00	-	-	6	0	2.83	4.83	2.33
30	44.35	73.69	7.20 (5)	50.00 (1)	150.00 (1)	58.22	37.78	20.44	-	-	9	8.00	2.78	3.11	6.33
50	81.14	134.94	-	-	-	295.00	157.00	93.00	45.00 (1)	-	1	3.00	2.00	1.00	10.00
Total	70.13	116.59	7.20 (5)	17.50 (6)	54.17 (6)	61.81	37.56	21.44	45.00 (1)		16	4.69	2.75	3.63	5.06
Area 4															
27	50.88	79.16	292.38 (24)	58.33 (6)	64.33 (5)	215.62	80.49	30.59	27.20 (5)	1037.50 (4)	41	3.46	2.68	3.73	8.20
51	69.02	119.20	31.57 (7)	-	-	72.33	47.33	25.00	-	-	9	9.22	2.44	3.11	7.56
58	54.53	81.41	-	55.00 (2)	232.50 (2)	155.50	68.00	87.50	-	-	2	18.50	3.00	4.50	8.00
59	82.74	147.54	49.11 (9)	0 (1)	0 (1)	55.00	36.10	18.90	-	-	29	10.48	2.41	1.79	8.69
59-A	54.60	86.76	-	41.25 (4)	102.50 (4)	110.00	75.00	35.00	-	-	2	19.00	2.50	4.00	9.00
Total	61.49	101.52	41.44 (16)	39.29 (7)	125.00 (7)	66.12	41.88	24.24	-	-	42	11.00	2.45	2.31	8.43
Area 5															
60	62.74	93.25	27.20 (44)	60.63 (24)	93.54 (24)	68.84	39.52	29.16	7.00 (2)	-	88	5.82	2.81	2.61	7.48
61	61.52	97.05	44.60 (165)	35.50 (30)	72.33 (30)	62.00	38.19	23.24	34.60 (5)	-	302	11.42	2.68	2.63	8.02
62-A	59.66	100.04	30.25 (12)	46.00 (5)	68.00 (5)	77.00	48.41	27.50	24.00 (1)	-	22	9.86	3.41	3.00	7.86
Total	62.21	94.69	40.36 (221)	46.61 (59)	80.59 (59)	64.26	39.02	24.73	26.38 (8)		412	10.14	2.74	2.64	7.90
Area 6															
62	62.07	99.42	11.50 (8)	5.00 (2)	12.50 (2)	52.84	27.69	24.36	22.00 (1)	-	13	4.00	3.54	2.62	7.85
64	62.94	96.83	6.33 (6)	10.00 (2)	25.00 (2)	24.18	16.47	7.71	-	-	17	1.53	3.00	1.41	7.24
65	70.47	117.13	170.00 (2)	5.00 (3)	5.00 (3)	70.29	49.29	21.00	-	-	7	6.00	3.00	2.86	8.14
67	61.63	95.50	40.08 (13)	11.00 (5)	42.00 (5)	47.28	29.36	17.92	-	-	25	6.36	2.88	2.16	7.64
Total	63.75	100.93	34.17 (29)	8.33 (12)	25.00 (12)	44.71	27.73	16.63	22.00 (1)	-	62	4.50	3.07	2.13	7.63
Area 7															
66	93.10	164.28	53.35 (48)	41.43 (14)	84.64 (14)	88.43	37.33	30.74	33.33 (3)	825.00 (2)	84	7.43	2.99	2.70	7.01
69	59.40	94.47	42.00 (18)	20.00 (3)	38.33 (3)	48.78	27.97	20.81	-	-	32	7.47	2.91	2.56	7.44
Total	88.66	155.07	50.26 (66)	37.65 (17)	76.47 (17)	77.49	34.75	28.00	33.33 (3)	825.00 (2)	116	7.44	2.97	2.66	7.13
TOTAL	67.91	110.42	92.48 (448)	46.73 (133)	78.96 (132)	76.09	41.48	26.25	45.35 (26)	900.00 (7)	890	7.87	2.69	2.83	7.64

hunter population. Hypotheses could be formulated and tested in each state. If similarities were found, it might then be possible to extrapolate this data to other states offering a similar resource.

Applications

To evaluate the economic efficiency of multiple-use trade-offs associated with elk habitat, the net economic value per WFUD should be utilized. As a simple example, suppose the wildlife biologist estimates that elk populations would double if habitat improvements were made in a portion of the state. Further, assume there is a demand for additional elk hunting opportunities. The biologist, recreation planner, and economist could then translate this doubling in elk populations to an increase in elk available for harvest. Once the increase in elk available for harvest is known, the theoretically correct way to calculate the additional long-run benefits of this change is to use this new level of available harvest as a shift in the demand curve. When the number of elk available for harvest increases, it is assumed that the demand curve shifts. This can be seen in figure 6 as the shift from D_1 to D_2. The increase in number of elk will be translated (in TCM) into existing hunters taking more trips and the nonhunters entering (or reentering) to become hunters because of the increased quantity. The theoretically correct benefits of these additional 500 trips (and hence an estimate of the change in benefits due to improved quality) is equal to the shaded area between the demand curves. This value is a long-run value because allowance was made for entry of new hunters in response to the increase in elk numbers. The assumption is made that congestion will not be a factor that causes benefits to decrease.

In field studies it is often difficult for biologists to have access to the original data, per capita demand curves for each site, and a program to calculate benefits with quality-induced demand shifts. Often the biologist will be able to translate the increase in population into an increase in supply of hunting trips. The economic benefit of the added trips that there is a demand for can be approximated by multiplying the increase in trips by the average net value per trip. For figure 6, suppose there are an additional 500 elk hunting trips per year. This 500 elk trips at a net willingness to pay of $100.00 per trip would yield annual benefits of $50,000. This would be compared to the economic costs of implementing habitat improvements. These costs may take the form of prescribed burns, restricted timbering, or reduced cattle grazing.

If the hunters' net willingness to pay (as revealed hypothetically by the $50,000) for the additional hunting trips is greater than the costs associated with habitat improvements, economic efficiency is improved by the management action.

Evaluations of benefits of increased elk populations do not necessarily flow only from more hunter days. In the short run, an increase in harvestable elk may benefit current hunters only. CVM questions asked in the survey can be used to estimate the increase in value to current users. By increasing elk populations, the demand curve for the elk resource shifts up to the right, leading to a higher value per day. These added benefits or marginal benefits can be calculated by taking the area between these two demand curves, holding number of trips constant. In terms of figure 6, the benefits being calculated here represents just the area between the demand curves for the current 500 trips (area ABCD). Continuing this example, if when elk populations double, the number of elk seen by existing hunters also doubles, then the CVM values can be used to calculate the area ABCD. Doubling the number of elk seen, would, according to the CVM results, increase the value of the existing 500 trips by about $57.00 per trip. This results in an increased value of $28,500 for doubling elk seen by existing hunters. However, this represents a little more than half the total long-run benefits.

These added values can be useful in evaluating changes in elk harvest regulations or resource actions that will change the total number of elk harvested or the type of elk harvested. Decisions made by integrating the economic values into project analyses of timber sales, grazing allotment management, right-of-way design, and habitat restoration investments will result in a more equitable use of valuable resources.

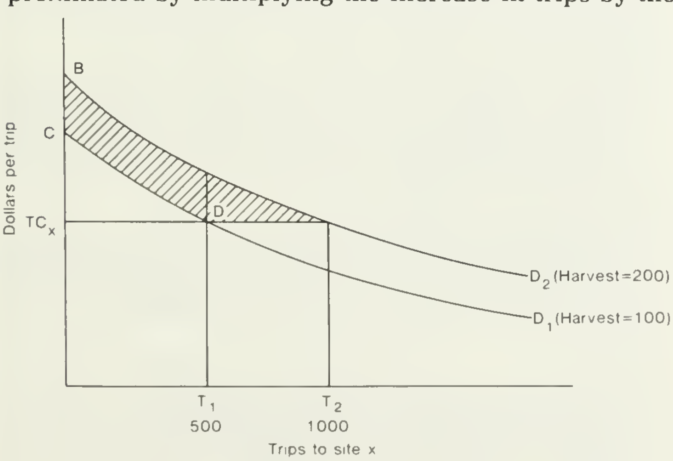

Figure 6.—Site demand curve for elk hunting

CONCLUSIONS

In deriving recreational values for elk hunting in Idaho, both methods used in this study—the Travel Cost Method and the Contingent Value Method—were based on the entire hunting season; therefore, it is possible to compare results. The study showed that, if the 1982 and 1983 elk hunting seasons are similar, then the average CVM value of a trip for 1983 ($92.54) is nearly identical to the reported cost TCM value ($99.82).

The TCM values using reported transportation costs are probably more accurate in the case of elk hunting than the standard cost TCM value ($63.17). Suburban driving in a mid-size car is reflected in the standard transport cost; however, in the case of elk hunting, pickup trucks on dirt roads may be more typical. The

reported cost for these vehicles would reflect these higher costs while the standard cost would not.

With TCM, substitute sites may be statistically significant variables, as shown by regression analysis. In this study, the RTCM per capita demand curve included statistically significant variables on distance, income, and site quality; however, no tested measure of substitute sites was found significant.

Both TCM and CVM have advantages and disadvantages when used in this study. The main advantages of CVM include the ease of data analysis for calculating the mean willingness to pay and ability to value discrete changes in the resource setting. Data analysis based on CVM is often straightforward and involves little analysis time. This, however, assumes a solid questionnaire design that specifies an appropriate payment vehicle, incorporates a protest mechanism, and presents individuals with a realistic, carefully designed situation on which to bid. Although not a factor in this elk hunting study, managers are often faced with valuing recreation that is nonprimary purpose and nonprimary destination in that individuals visit a location in conjunction with other locations. In such cases, TCM cannot be implemented and CVM offers the best method to value these users. Additionally, managers may want to know the effect of incremental quality changes on recreation value. If several quality alternatives are feasible, CVM can be easily implemented to measure the benefit of alternative scenarios. The primary disadvantages of CVM are not only the necessity to have the expertise to design an appropriate questionnaire, but the cost of collecting an adequate sample.

The primary advantages of TCM relate to its reliance on actual behavior and the ability to use existing data. A major criticism of CVM relates to the hypothetical nature of the survey, and as a result TCM is often more desirable. Often cost prohibits collection of extensive primary data; therefore, if origin-destination data already exist in the form of permits or license plates numbers, etc., then TCM would become more cost-effective than CVM in valuing recreation activities.

Perhaps the biggest practical disadvantage of TCM is the time it takes to construct a Regional Travel Cost Model. Data aggregation, computing additional variables, selecting variables for regression, and selection of the value of travel time is time-consuming. Once a statistically significant regression is found, calculation of a second stage demand curve and sensitivity intervals involves little additional work. However, it involves specialized computer programs. Thus, benefit estimation involves more time, computer knowledge, and statistical expertise than is necessary for CVM.

Choice of CVM or TCM involves many considerations: type of user to be sampled, availability of secondary data, expertise in questionnaire design, statistical and computer knowledge, and the research budget, to name a few. No method is superior in all cases; for each case, a determination will need to be made as to which method is preferable.

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APPENDIX

Marginal and Average Consumer Surplus—Conditions of Equality

The objective of the proof is to show that average benefits are equal to marginal benefits in relation to the per capita (stage I) demand curve. The means to accomplish this is to derive the mathematical expression for the benefits in each case and to show these are equal.

The conditions under which this is true are:

1. Demand relationships between visits per capita and price (cost of travel) can be validly modeled with a semilog functional form such as

$$\ln(q) = a - bp \qquad [A1]$$

or equivalently,

$$q = e^{a-bp} \qquad [A2]$$

where q is quantity, in this case, visits per capita
p is price, in this case, travel cost
a is the intercept parameter
b is the slope parameter

2. The only shifting variables allowed in the equation affect the intercept. No slope shifting variables are in the equation.
3. A slight relaxation of condition 2 occurs if there are slope shifting variables but they do not change from the "before" to the "after" states.
4. Each origin is a price taker in that people from that origin may visit the site as many times as they desire at their current travel cost. Therefore, the supply curve facing a given origin is horizontal. Due to differences in location from the site, each origin faces a different horizontal supply curve.

The "Before" State

Figure A–1 shows the overall scope of the changes considered in the proof. At equilibrium in state 1, i.e., the "before" state, the demand curve has a quantity intercept of e^{a_1} when price is zero. As price increases, quantity decreases and asymptotically approaches zero for very large p. For a price of p_1, visits per capita to a site from a specific origin are q_1.

Total benefits per capita that accrue to the presence of the site, given all other existing sites, are represented by the shaded area labeled CS_1 (consumer surplus in state 1). This area is found by integrating under the demand curve and above the price line p_1.

Let a small segment of the area, dCS, be

$$dCS = q\,dp \qquad [A3]$$

as shown in figure x.

Then

$$CS = dCS = \int_{p_i}^{p} q\,dp \qquad [A4]$$

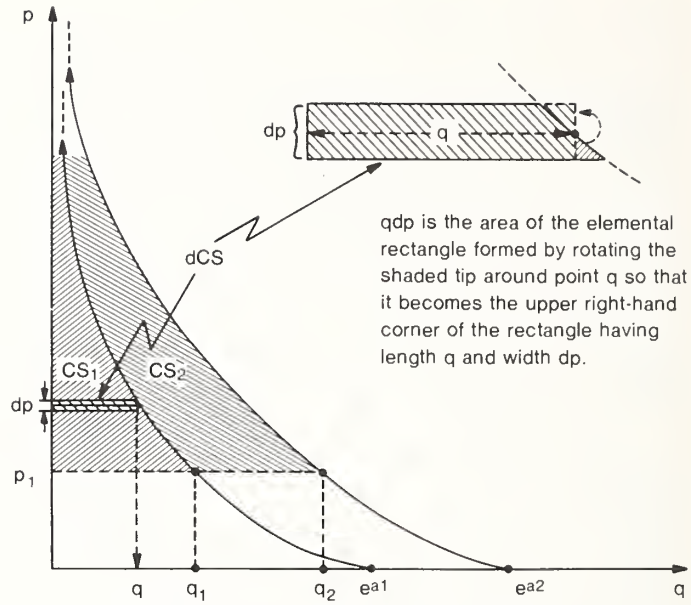

Figure A-1.—Changes in consumer surplus.

The limits of integration define the lower boundary of the CS area, the p_1 price line, and the upper boundary of the CS area, the point where p goes to infinity and q goes to zero. In spite of these extreme values, it turns out the CS area is finite.

Substitute for q from equation [A2] in the integral in equation [A4] giving

$$CS_1 = \int_{p_i}^{p} e^{a_1 - b_1 p}\,dp \qquad [A5]$$

where the subscript 1 denotes state one ("before"). Continuing with the integration gives

$$CS_1 = e^{a_1}\int_{p_1}^{p} e^{-b_1 p}dp = -\frac{1}{b_1}\, e^{a_1 - b_1 p}\Big]_{p_1}^{p} \qquad [A6]$$

Evaluating the expression in [A6] at the limits of integration gives

$$CS = -\left(\frac{1}{b_1}\, e^{a_1 - b_1 p}\right) - \left(-\frac{1}{b_1} e^{a_1 - b_1 p_1}\right) \qquad [A7]$$

$$CS_1 = \frac{1}{b_1}\left(e^{a_1 - b_1 o_1} - e^{a_1 - b_1 p}\right) \qquad [A8]$$

In order to include the entire area under the demand curve, let p (not p_1) become infinitely large, ($\rightarrow \infty$). For large p

$$e^{a_1 - b_1 p} = q \rightarrow 0 \qquad [A9]$$

so that the expression for CS in [A8] becomes

$$CS_1 = \frac{1}{b_1}\left(e^{a_{21} - b_1 p_1}\right) = \frac{q_1}{b_1} \qquad [A10]$$

Average consumer surplus in state one per trip made (q_1) is

$$\overline{CS}_1 = \frac{CS_1}{q_1} = \frac{1}{b_1}\left(e^{a_1 - b_1 p_1}\right)\frac{1}{q_1} \quad [A11]$$

But $e^{a_1 - b_1 p_1}$ is q_1, so [A12]

$$CS_1 = \frac{1}{b_1}$$

Thus, average consumer surplus per trip in state one, the "before" state, is simply the inverse of the slope parameter from the demand equation, assuming the conditions previously stated are met.

The "After" State

Now assume that managers of the recreational sites under consideration wish to increase the attractiveness of the specific site, for example, by increasing the number of animals or fish potentially harvestable. This new condition becomes the "after" state.

The new attractiveness at the site increases the intercept to e^{a_2}, but does not affect the slope coefficient b, as we have assumed, so $b_1 = b_2 = b$, (i.e., quality is an intercept shifter only). Using the result of the previous section, that, in general under the stated conditions,

$$CS = \frac{1}{b}\left(e^{a-bp}\right) = \frac{q}{b} \quad [A13]$$

and placing the subscript (2) for the "after" state on the variables, total per capita consumer surplus for the "after" state is

$$CS_2 = \frac{1}{b_2}\left(e^{a_2 - b_2 p}\right) = \frac{q_2}{b_2} \quad [A14]$$

Note that "after" average CS is also $\frac{1}{b_2} = \frac{1}{b}$.

The total change in consumer surplus from the "before" to the "after" state is

$$\Delta CS = CS_2 \; CS_1 \quad [A15]$$

$$\Delta CS = \frac{q_1}{b_2} - \frac{q_2}{b_1} \quad [A16]$$

But, as noted, $b_2 = b_1 = b$, so

$$\Delta CS = \frac{q_2 - q_1}{b} \quad [A17]$$

The marginal change per unit increase in trips is defined as

$$\frac{\Delta CS}{\Delta q} = \frac{\frac{q_2 2_1}{b}}{q_2 - q_1} \quad [A18]$$

So

$$\frac{\Delta CS}{\Delta q} = \frac{1}{b} \quad [A19]$$

And since $b = b_1 = b_2$, combine the results of the derivation of "before" average consumer surplus and the derivation of the marginal consumer surplus caused by the change to the "after" state.

Thus,

$$\overline{CS}_1 = \frac{1}{b} = \frac{\Delta CS}{\Delta q} = CS_{marg} = \overline{CS}_2 \quad [A20]$$

and the proof is complete given that the preceding conditions are met.

Note in the proof that the relationship in equation [A20] does not depend on the price level even though figure x shows price unchanging. Neither do the key equations for "before" and "after" consumer surplus, equation [A10] and [A14], respectively. Under the stated conditions, there may or may not be a price change along with the demand curve shift. Regardless, it does not affect the equality between the "before" average consumer surplus and the "before" - to - "after" marginal change in consumer surplus. Moreover, the price may change in either direction without affecting the results.

Therefore, with this functional form multiplying the average consumer surplus of a trip or WFUD by the change in trips or WFUDs due to one of the three factors discussed above will result in an exact estimate of the area between the demand curve associated with that change in trips or WFUDs. This is a result specific to this functional form. Therefore, if the field analyst has an idea of change in trips associated with some management action, the analyst can calculate an estimate of the change in economic efficiency benefits associated with that change in days without having to shift the second stage demand curve.

Sensitivity Intervals

The estimate of net willingness to pay is the end result of a series of mathematical and statistical operations on the aggregated data. One item of interest about estimated net willingness to pay is the sensitivity of this estimate to variation within the travel cost data. This variation is initially seen in the computed statistical confidence interval associated with the estimate of each coefficient of the visit-per-capita regression model.

Conceptually, this variation is carried through all the steps described previously, including formation of the second stage demand curve and the subsequent integration under it. Thus, it is logical to talk about variation associated with estimated net willingness to pay.

However, the confidence interval estimates of net willingness to pay are not yet completely developed. Despite this, certain aspects of sensitivity may reveal information about the variability of benefit estimates. Specifically, for this research, a "sensitivity interval" was defined. This interval, for estimated benefits measured by willingness to pay, describes the upper and lower bounds of the benefit estimate when the regression coefficient of distance is varied to the upper and lower bounds of its confidence interval.

For example, the computer program that calculates benefits is run three times—once with the distance coefficient at its best unbiased level, once with it at the lower level of its 95% confidence interval, and once with the distance coefficient at the upper level of its 95% confidence interval. The three estimates of benefits related to elk hunting respectively indicate how benefits vary with respect to variation in the coefficient associated with distance. Distance was chosen specifically because increased increments of this independent variable measure additional cost hypothetically incurred by hunters. In this bulletin, these sensitivity intervals are compared to the confidence intervals derived from the contingent valuation. This comparison is not a statistical procedure, but it provides an indication of the relative ranges in estimates produced from each method.

Elk Hunting Survey Questionnaire

Tag Type ____________
Tag No. ____________

Continue if this person did hunt ____________ in 1982

In addition to getting hunter success, the Department and the University of Idaho are asking a sample of hunters to answer questions to help determine the value of Idaho's ____________
elk, deer

Can you please tell me how many ____________ hunting trips you made and to what units ____________ in 1982?

Unit No.	Drainage or general area	Counting yourself, no. people in your vehicle with ____ tags.
1.		
2.		
3.		

Now, I would like some specific information about each trip:

(Ask separately about each trip even if to some area more than once.)

Did you visit more than one unit on your trip (or 1st, 2nd, 3rd trip) to unit ______. If so, how many other units (list) __________ __________ __________ __________ .

Did you drive the entire distance to where you went hunting in unit ______? Total distance traveled round trip __________.

If no, what different type of transportation did you use?

car small plane airline horses jet boat back pack other

____

How many days did you hunt on this trip to unit (to nearest ½ day) ____________ and average number of hours spent hunting per day ____________.

Now, please estimate the total amount you spent on this trip for:

Transportation ____________________

Food ____________________

Motel-hotel ____________________

Guide Services ____________________

Do you feel this trip to unit ______ was worth more than you actually spent __________?

(If no, stop - if yes, go on to next question)

One final question about this trip:

The cost of everything is increasing. How much would the trip cost have to rise above what you spent this year before you would not hunt ____________ in unit ____________ again? $ ____________.

Sorg, Cindy F., and Louis J. Nelson. 1986. Net economic value of elk hunting in Idaho. USDA Forest Service Resource Bulletin RM–12, 21 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Net willingness to pay for elk hunting in Idaho was estimated at $63.17 per trip and $99.82 per trip using a standard cost per mile travel cost method and a reported cost per mile travel cost method, respectively. Using the contingent value method, the values for the 1982 and 1983 elk hunting seasons were $51.84 per trip and $92.54 per trip, respectively. Willingness to pay was greater for double the number of elk seen on a trip. Methods, results, and applications are fully described.

Keywords: Travel Cost Method, Contingent Value Method, elk hunting, Idaho, economic efficiency, expenditures

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Keywords: Travel Cost Method, Contingent Value Method, elk hunting, Idaho, economic efficiency, expenditures

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Rocky Mountains

Southwest

Great Plains

U.S. Department of Agriculture
Forest Service

Rocky Mountain Forest and Range Experiment Station

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

RESEARCH FOCUS

Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

RESEARCH LOCATIONS

Research Work Units of the Rocky Mountain Station are operated in cooperation with universities in the following cities:

Albuquerque, New Mexico
Flagstaff, Arizona
Fort Collins, Colorado*
Laramie, Wyoming
Lincoln, Nebraska
Rapid City, South Dakota
Tempe, Arizona

*Station Headquarters: 240 W. Prospect St., Fort Collins, CO 80526